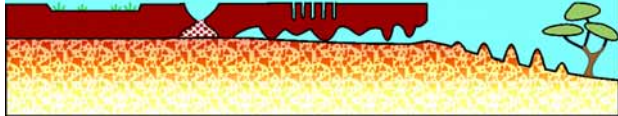


Laterite Karst

Ken Grimes
&
Andy Spate

ASF April 2011



Laterite Karst

Talk to ASF Chillagoe, April 2011
15+5 =20

- * There are many types of karst-like feature in Laterites.
- * Analogies in form could be a useful guide to analogies on **processes** and also in predicting possible **karst-like geological hazards** in DWPs.
- * There are some particularly good analogies with the **Syngenetic karsts**.
- * The emphasis in this paper is simply to illustrate the similarity in karst-like landforms, I will not say too much about processes or hazards.

Terms & Concepts

■ KARST landforms

Underground erosion (caves, conduits)
Surface: disrupted drainage, dolines, karren etc ...

■ Three settings

- **KARST:** Solution dominates
- **PARAKARST:** Solution & Physical erosion
- **PSEUDOKARST:** Physical processes dominate

■ Syngenetic Karst:

Simultaneous lithification & solutional karstification

TERMS

- * **Karst-like Landforms:** defining process is U/G erosion (by solution or otherwise)
- * The **3 Types** of K landform (discussed in separate paper)
 - * **KARST** = solution dominant & rapid
 - * **ParaKARST** = Mixed slow solution & physical erosion
 - * **PseudoKARST** = Physical processes dominate.

ALSO

The Lat Ks show particularly strong analogies to the **Syngenetic Karsts**
Both have simultaneous lithification & karstic solution + caprocks

Terms & Concepts

■ LATERITE Karst

Used here in the general sense for Karst-like features in all Deep Weathering Profiles (DWP)
Ferricrete, Silcrete, Bauxite, etc ...

■ Deep Weathering Profiles (DWPs)

- Duricrust capping, (Fe, Si, Al, ...) over ...
- Deeply weathered material (up to 100m or more)

■ DWP Processes

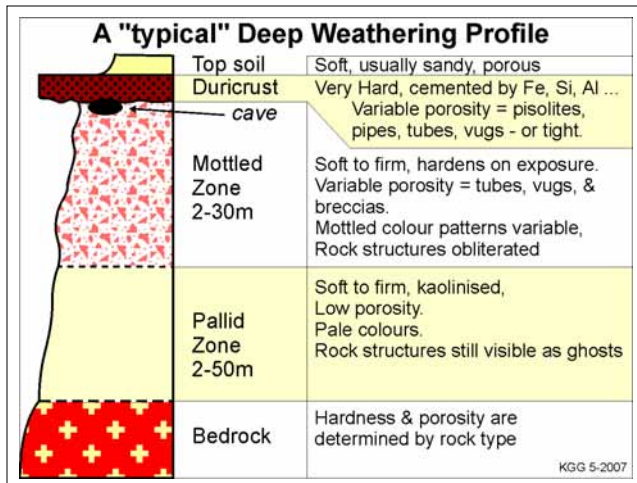
Chemical weathering (including solution) followed by physical erosion of soft or friable material.

■ Most common in the tropics

But **not** restricted to those regions

TERMS

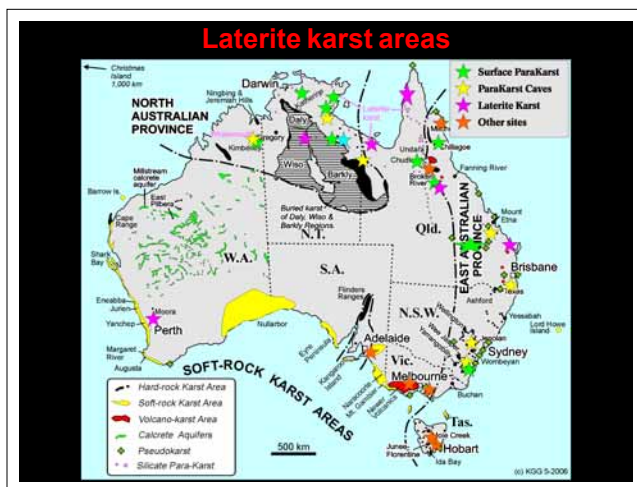
- * **Laterite:** used here in broadest sense. All DWPs (Fe, Si, Al etc)
- * Processes = **Chem weath** (incl solution) ... PLUS **physical** erosion.
- * DWPs = the full profile:
duricrust/weath/bedrock (see next slide)
- * Most common in tropics (but not restricted to there - eg Chittering)



"Typical" DWP
NB a lot of variation.

- * Duricrust (Fe, Si, AL, ... and in SGK's it is Calcrete caprock)
- * Mottled = still called that
- * Pallid = Plasmic (structure gone)
/ Saprolite (ghost structures)
/ Saprock (<20% mins modified)
- * Bedrock

Location map of Laterite Karst sites in Australia



Point out (magenta stars)

- * Sturt Plateau NT
- * Various pans areas
- * White Mtns NP (pinnacles)
- * Mystery craters, Qld
- * Chittering WA

Lat K features occur at all scales

Large
Med (incl caves)
Small

We will work through that list...

Laterite Karst Features

- **Large Scale**
Pans, Collapse dolines, Ruiniform relief (mega-karren)
- **Medium Scale**
 - **Caves:** Eroded beneath duricrust
 - **Surface:** Dolines, Pinnacles, Pipes, Walls, Karren
- **Small Scale**
Vuggy & tubular porosity, Breccias



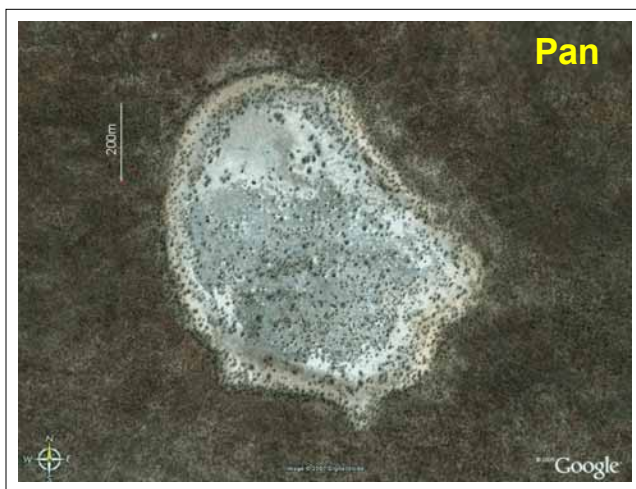
Pans

= broad ($\leq 2\text{km}$) but shallow (a few m) flat-floored or basin-shaped, swampy or seasonally flooded depressions.

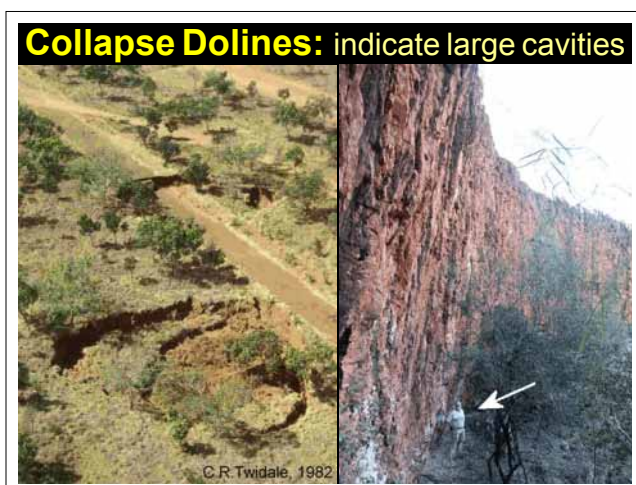
May link up to form **Dambos**.
COMMON in the flat-lying laterite plains of N Aust

= shallow solution + subsidence
+ later mods by other processes (eg deflation)

(West coast, C.Y. Penn, Qld)



Detail of a Lat K Pan (Quick view)
(Doomadgee Plain NW Qld)

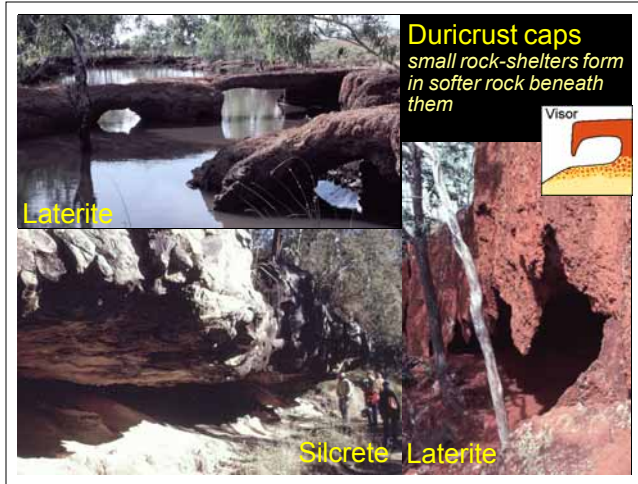


Collapse Dolines

in lateritised Cretaceous claystone
BUT Pz Lstn at depth - so might be subjacent?

But McFarlane & Twidale argue for solutional cavities within the DWP (GPR & Seismic).

Sturt Plateau.NT



Duricrusts

Duricrusts = 'caprock' can be cemented by Fe, Si, Al etc or by Calcrete (in the case of syngenetic karst)

Caves (rock shelters and larger things) typically form as shallow low-roofed cavities beneath a caprock

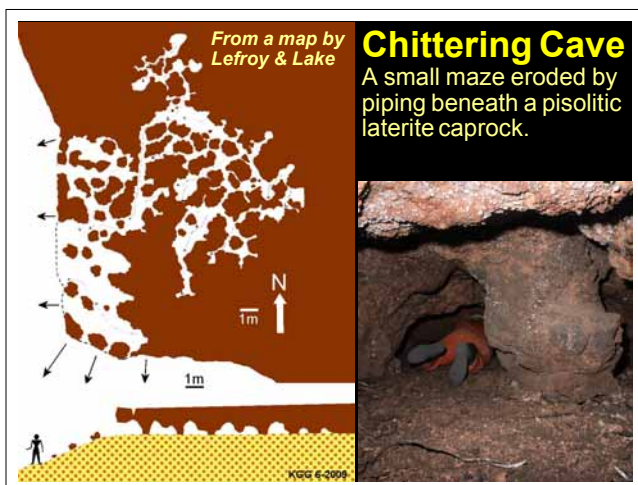


CAVES

Typically form as shallow low-roofed cavities beneath a caprock

Top = **Laterite K**: laterite/bauxite duricrust at Chittering WA
Bottom = **SGK**: Calcrete cap at Naracoorte, SA

Note pendants on both cases - cementation is uneven at base of crust.



Map & profile of maze cave in Laterite

Numerous pillars & pendants of harder material beneath the main crust form a maze
Presumably a softer mottled material below (but no outcrop)

Photo shows general size & a pillar

Chittering Laterite cave, WA

In the Chittering maze cave, WA

photo shows pillars, roof pendants & a solution pipe with indurated rim.

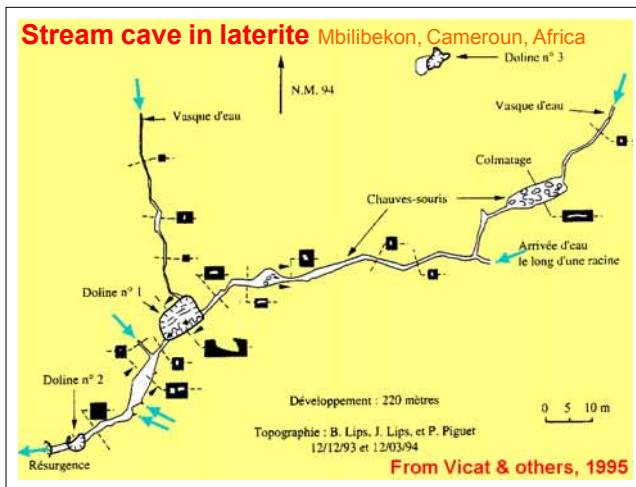


Stream caves in DWPs

Map of example from central Africa.

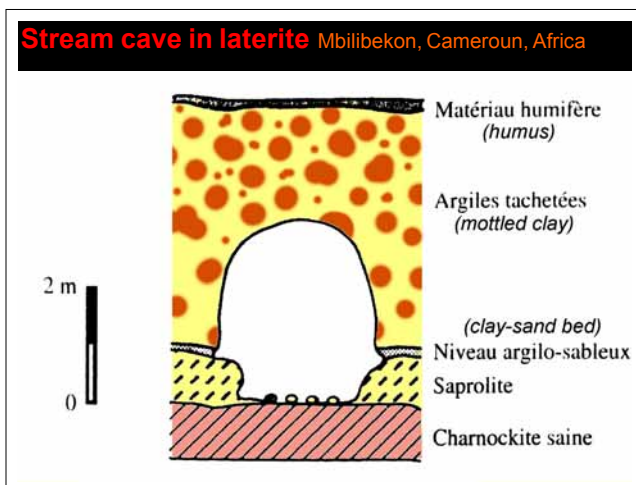
Several stream inputs. join up and exit
Cave follows base of mottled material above granitic bedrock (see next slide)

From Vicat et al, 1995 Karstologia 26(2).

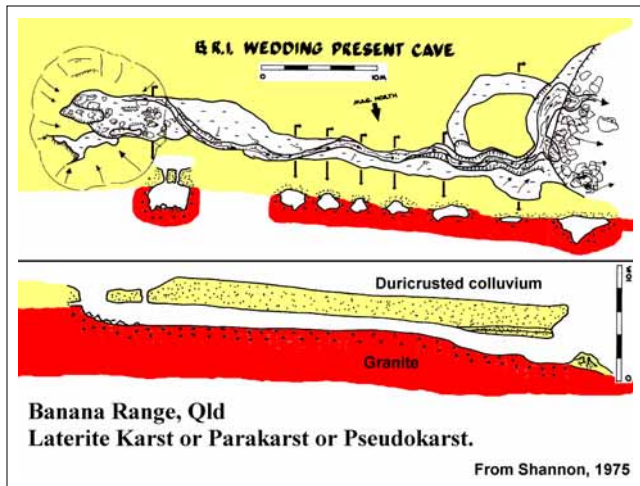


Stream caves in DWPs

Cross section showing lithol control on stream passage level.
Cave follows base of mottled material above granitic bedrock



**** Take time off here to mention some other caves in Africa, S.Am. etc.....
* eg De Chételat (1938) describes systems of interconnected chambers and passages under a ferricrete cap, with pillars supporting roof, but does not state the overall size.
* Bowden 1980: Caves & pipes in lat
* Canga & Lat Caves in S.Am: Simmons, 1963; Pilo & Auler, 2005; Laffer 1958 (Y-shaped C in lat ~190m passage); Urban & Szczerban, 1974 NSS-News, brief mention of a 1000m system but not detail or refs!



Australian stream cave (?)

Banana Range, Qld (after CHC Shannon, 1975)

3 x Caves follow contact between duricrusted colluvium & granite. Underground capture of surface stream + piping & spring sapping(?).

NB similarity in form to Hilltop Natural Tunnel (NSW) but different rock.

Is this a "Laterite Karst" stream cave?



Smaller dolines

Photo of solutional(?) dolines and pipes in mottled zone of a laterite. Originally infilled by loose sandy soil (excavated by an inquisitive farmer) Could be regarded as an "epikarst" surface?

The "Mystery Holes", SE Qld.



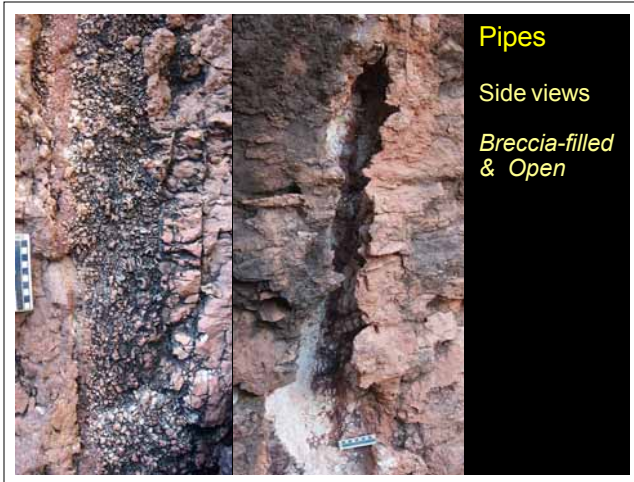
Fields of solution pipes

Left = SGK calcrete band. (Gambier karst SA)

Right = laterite mesa top (Castle Rock, NT)

Form by solution by **Focussed** downward vadose flow through a porous sediment
In this case, aggressive water, so solution.

Pipes: vertical sections



Left = breccia filled

Right = open pipe

Both in sinkhole on Sturt Plateau, NT

Comparison of Pinnacles

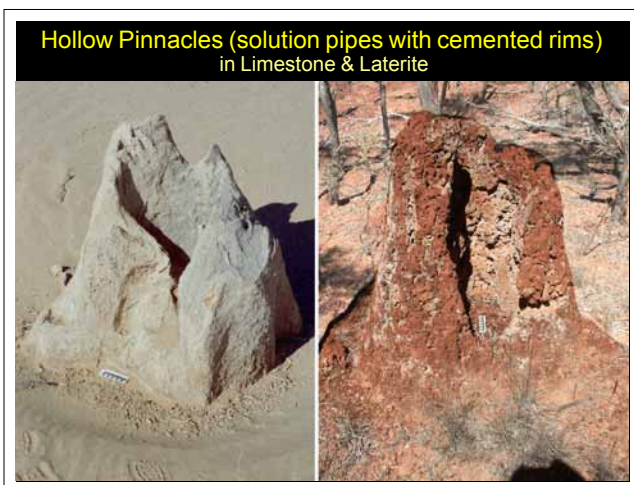
Left = SGK dune lstrn (Nambung WA)

- NB bedding + a filled SP

Right = Ps in laterite, exposed by retreating scarp, (White Mtns, N Qld.)

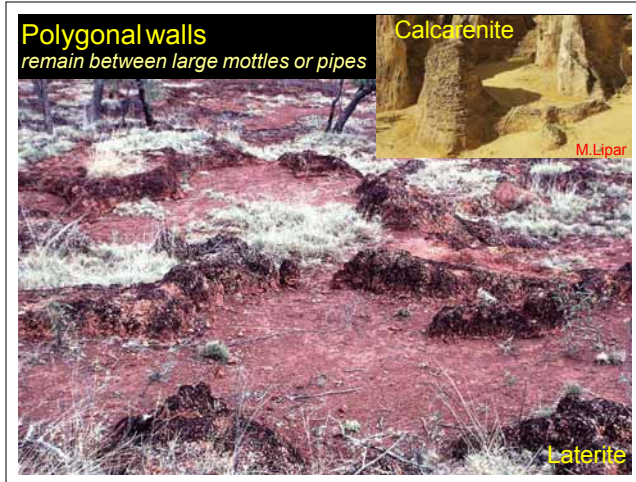


Hollow Pinnacles = Pipes + cemented rims.



Left = SGK dune lstrn (Nambung WA - ~1-2% are hollow)

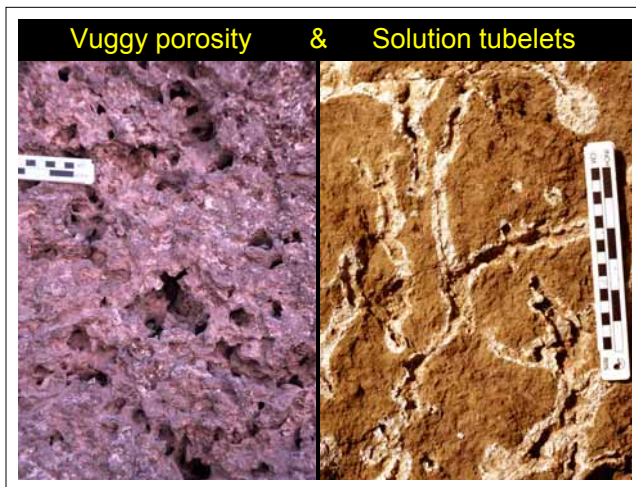
Right = Hollow P in laterite (White Mtns, N Qld ~50% are hollow)



Polygonal Walls

Probably formed by expansion of pipes (in width) and partial coalescence, leaving a narrow rim.

Inset = similar small polygonal walls connecting pinnacles in Calcarenite at Nambung.

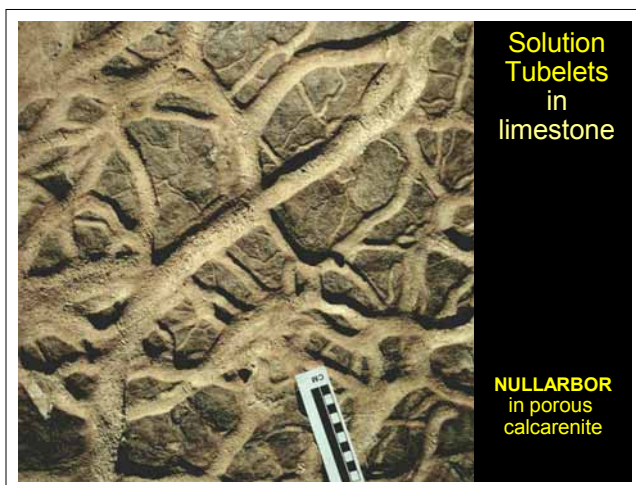


Small Scale features

Left = vuggy porosity in a ferricrete (Weipa mine, N Qld) Strong flows in wet.

Right = 3D network of solution tubelets (with halos) - in a DWP (Charters Towers, N Qld)

cf small tubelets in limestone (next slide) & sandstone (separate talk)



Solution tubelets in limestone (for comparison)

Generally considered to be the "first stage" in cavern development

(Nullarbor K, WA) - this is soft porous calcarenite.

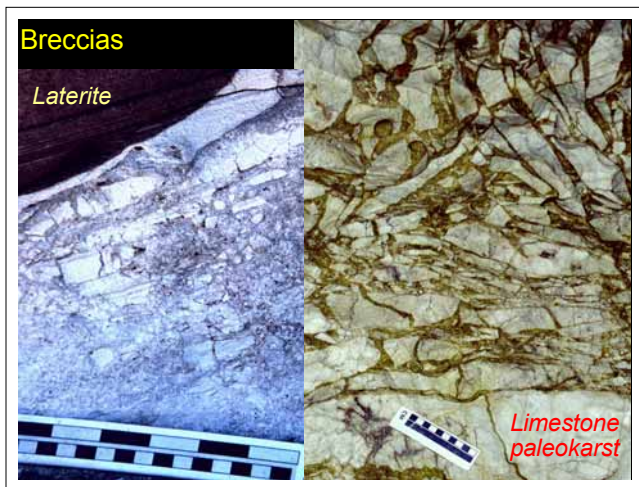


Breccias.

Not often discussed in modern karst, but are present.
Important in paleokarst.

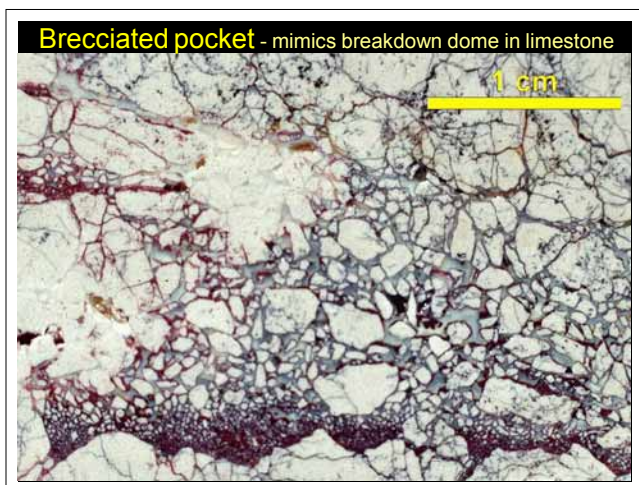
Photo = brecciated pocket in a mega-mottled siltstone. Shows some unrotated frags (crackle breccia)

(Lake Buchanan, Qld)



Breccias:

Left = in laterite (same as previous photo)
Right = paleokarst crackle breccia in Limestone cave (Wombeyan)



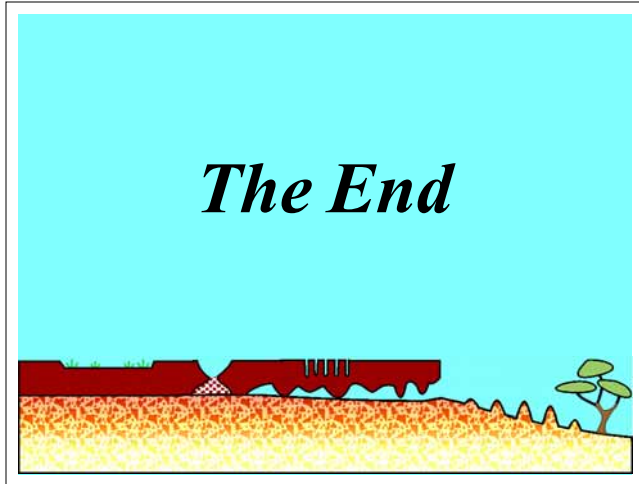
Small brecciated pocket (hand specimen)

Mimics a breakdown chamber in a limestone cave

Roof is stoping upwards. Rubble is breaking up and being further dissolved at base + dark insoluble residue.

Grey matrix = later stage opal fill.

(Donors Plateau, NW Qld)



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